

Remarks

Reconsideration of this application in view of the above amendments and following remarks is respectfully requested. Claims 8-10 and 20-28 are now pending. Claim 1 has been canceled. Claims 2-7 and 11-19 were cancelled in a prior amendment. Claims 8, 9 and 10 have been amended.

By Office Action mailed June 15, 2004, certain claims stood allowed and/or objected to, while other claims stood rejected. For purpose of clarity, Applicants will first address the allowable subject matter, and then turn to the outstanding rejections.

Allowable Subject Matter – Claims 9, 10, 20, 21 and 28

Claims 20, 21 and 28 stand allowed.

Dependent claims 9 and 10 stand objected to as being dependent upon a rejected base claim (*i.e.*, claim 1), but would be allowable if rewritten in independent form. To that end, Applicants have amended each of claims 9 and 10 to recite as independent claims.

Accordingly, Applicants respectfully request that claims 20, 21 and 28, as well as amended claims 9 and 10, be passed to issuance.

Rejection of Claim 8

Claim 8 stands rejected as obvious over GB 2316802 (“GB 802”) in view of U.S. Patent No. 5,958,613 (“the ‘613 patent”). Applicants respectfully disagree.

As an initial matter, Applicants have amended claim 8 to recite in independent form. As amended, claim 8 recites, in part, that the density of the first electrode substrate increases as it is traversed in-plane in the direction of the first reactant flow path. GB 802 does not teach or suggest a first electrode substrate having a density that increases as it is traversed in-plane in the direction of the first reactant flow path.

Rather, in GB 802 the porosity matrix is homogenous as it is traversed in-plane to the direction of the reactant flow path, and asymmetrical through the matrix (the Examiner considers a change in porosity to evidence a corresponding change in density). As used in claim 8, the phrase “direction of gas flow” means from the first port to the second port such that the

flow path extends in-plane across the electrochemically active area. In contrast, the phrase “direction of gas flow” as used in GB 802 means gas flow through the electrode matrix, from one face to the other – in other words, the porosity changes in a direction through the electrode matrix. This direction of flow is evident upon reference to page 22, lines 7-16, of GB 802. This portion of GB 802 clarifies that the direction of gas flow, after entering the electrode, is through the less resistant surface and toward the denser portion of the matrix. Thus, as stated at page 22, lines 13-15, “the electrode matrix of the [GB 802] invention has an anisotropic porous structure with two asymmetric surface layers …” These asymmetric surface layers yield a matrix that is “asymmetrically porous” to gases in the direction of gas flow (*i.e.*, through the matrix), but “homogenously porous” in the direction lateral to gas flow (*i.e.*, across the matrix). As the Examiner will appreciate, a matrix that is “homogenously porous” across the matrix is directly contrary to the subject matter recited in claim 8 – that is, a cathode substrate having a density that increases as it is traversed in-plane in the direction of the first reactant flow path.

In summary, Applicants respectfully submit that GB 802 does not teach or suggest the invention as recited in claim 8. Furthermore, the addition of the ‘613 patent does not cure this deficiency. The ‘613 patent is entirely silent as to this issue, and thus does not add anything to the teaching of the GB 802 patent with regard to this patentable distinction.

Accordingly, since this is the only ground of rejection as applied to claim 8, Applicants request that this ground of rejection be withdrawn and that claim 8 also be passed to issuance.

Rejection of Claim 1

While Applicants do not agree with the various rejections as applied to claim 1, this claim has been canceled in order to expedite issuance of the remaining claims. Of course, cancellation of this claim is not, nor should it be construed as, acquiescence to the outstanding rejections. Further, Applicants specifically preserve the right to continue prosecution of the cancel subject matter in one or more related continuation applications.

Rejection of Claims 22, 23 and 24

Claims 22, 23 and 24 stand rejected under 35 U.S.C. §103(a) as being obvious under published PCT WO 97/08766 (“PCT ‘766”) in view of the ‘613 patent. Applicants respectfully traverse this ground of rejections for the reasons set forth below.

Each of claims 22, 23 and 24 recites that either the structure (claim 22), a fluid transport property (claim 23), or the material composition (claim 24) of the first electrode substrate varies substantially symmetrically as the electrochemically active area thereof is traversed in-plane in the direction of the first reactant flow path. This feature is not taught or suggested by PCT ‘766.

Rather, as the title of PCT ‘766 indicates, this document is directed to an electrode substrate having an in-plane nonuniform structure for control of reactant and product transport. In this regard, the Examiner is of the opinion that, “[a]s shown in Figures 5-7 [of PCT ‘766], the structure of the electrode may vary symmetrically as the active area is traversed” (see 6/15/04 Office Action at page 3, 6 lines from the bottom of the page). Applicants respectfully, but strongly, disagree with this statement, at least as the phrase “substantially symmetrically” is used in the context of the pending claims.

Figures 3A, 3B and 3C of the pending application illustrate graphically how various properties of a fuel cell electrode may vary symmetrically as the electrochemically active area is traversed in-plane in the direction of the reactant flow path. This should be contrasted to Figures 4A, 4B and 4C, which illustrate how such properties can vary in a biased manner. The importance of such symmetry is discussed at page 4, lines 13 of the specification. In short, this embodiment is particularly preferred in fuel cells in which the flow direction of reactant is periodically reversed, and the first and second ports alternate their functions as inlet and outlet ports.

PCT ‘766 simply does not teach or suggest an electrode substrate having such symmetry as the electrochemically active area thereof is traversed in-plane in the direction of the first reactant flow path. Figures 5-8 of PCT ‘766, as relied upon by the Examiner, disclose structural nonuniformity (*i.e.*, grooves, openings, etc.) that are introduced at regular intervals

across the entire electrochemically active area – that is, there is no uneven distribution or irregular spacing of structural in-plane nonuniformity.

On the other hand, the Examiner is correct in pointing to Figures 14A and 14B, which disclose in-plane structural nonuniformities (in this case, grooves and openings, respectively) that are irregularly spaced across the substrate. However, even in these embodiments, the irregularity in the spacing does not vary substantially symmetrically as the electrochemically active area thereof is traversed in-plane in the direction of the first reactant flow path. Rather, such irregular spacing of Figures 14A and 14B is analogous to the biased spacing as illustrated in Figures 4A, 4B and 4C of this application. In other words, if the reactant flow direction is reversed, the irregularly spaced nonuniformities would not present in a substantially symmetrical manner.

In summary, each of claims 22, 23 and 24 recites a feature of the first electrode substrate that varies substantially symmetrically as the electrochemically active area thereof is traversed in-plane in the direction of the first reactant flow path. This feature is clearly not taught by PCT '766, nor is such a feature suggested by Figures 14A and 14B, which illustrate variation in a biased (as opposed to symmetrical) manner. Also, the addition of the '613 patent does cure this deficiency. Rather, the '613 patent is entirely silent as to this issue, and thus does not add anything to the teaching of PCT '766 with regard to this patentable distinction.

Accordingly, Applicants respectfully request that this ground of rejection be withdrawn as applied to claims 22, 23 and 24, and that these claims be passed to allowance.

Rejection of Claims 25, 26 and 27

Claims 25, 26 and 27 stand rejected under 35 U.S.C. §103(a) as being obvious under PCT '766 as applied above, and further in view of U.S. Patent No. 5,702,839 ("the '839 patent"). Again, Applicants respectfully traverse this ground of rejection. As an initial matter, Applicants submit that claim 24 is patentable for the reasons discussed in the preceding section. Since claims 25, 26 and 27 are dependent (directly or indirectly) from claim 24, such dependent claims also constitute patentable subject matter for the same reasons as applied to claim 24.

In addition, the teaching the '839 patent does not cure the deficiencies noted above with regard to the disclosure of PCT '766. Claim 24 recites the embodiment wherein the material composition of the first electrode substrate varies substantially symmetrically as the electrochemically active area thereof is traversed in-plane in the direction of the first reactant flow path, while dependent claims 25, 26 and 27 recited more specific embodiments thereof. While the '839 patent is directed to a non-uniform electrode layer, such a layer is deposited in a biased manner. In particular, the '839 patent states, at col. 8, lines 43-47:

In this example, the non-uniform electrode layer takes the form of the electrocatalyst having a gradient loading oriented such the highest loading region corresponding to the gas inlet and the lowest at the region corresponding to the gas outlet. (*emphasis added*)

As the Examiner will readily appreciate, the above "gradient loading" pattern of the '839 patent does not vary substantially symmetrically as the electrochemically active area thereof is traversed in-plane in the direction of the first reactant flow path. Rather it varies in a biased manner – from high loading at the inlet to low loading at the outlet. If one reversed the flow of the reactant stream, the loading changes to low loading at the inlet and high loading at the outlet, which clearly does not constitute a substantially symmetrical variation in the loading between the two inlet/outlet ports.

In summary, Applicants again submit that PCT '766 does not teach or suggest this aspect of the claimed invention, and that the addition of the '839 patent does not cure this deficiency. Accordingly, Applicants respectfully request that this ground of rejection be withdrawn as applied to claims 25, 26 and 27, and that these claims be passed to allowance.

Double Patenting

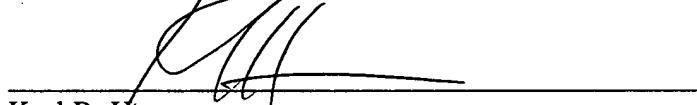
The Examiner has provisionally rejected claims 22, 23 and 24 under the judicially created doctrine of obviousness-type double patenting as unpatentable over claims 20-41 of co-pending U.S. Application 10/079,612. In this regard, Applicants note that the '612 application is being examined by the same Examiner as the present application, and that the pending claims of the '612 application currently stand rejected for the same or similar reasons as applied to the pending claims of this application.

Since this is a provisional rejection only, Applicants would prefer to postpone taking action until such time as the pending claims have been found allowable. Should the Examiner consider the present claims to be in condition for allowance at the present time, Applicants request that they be passed to issuance. Applicants will then address this ground of rejection in the co-pending application noted above.

In view of the above amendment and remarks, allowance of claims 8, 9, 10, and 20 through 28 is respectfully requested. A good faith effort has been made to place this application in condition for allowance. However, should any further issue require attention prior to allowance, the Examiner is requested to contact the undersigned at (206) 622-4900 to resolve the same.

Respectfully submitted,

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